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Evaluation of Modeled Air Pollutants for Health Implications

Buckingham Compressor Station
Buckingham County, Virginia

Letter Health Consultation

September 18, 2019

Virginia Department of Health
Office of Environmental Health Services
109 Governor Street
Richmond, Virginia 23219

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September 18, 2019

Mr. David K. Paylor, Director
Department of Environmental Quality
P.O. Box 1105
Richmond, VA 23218

Dear David Paylor,

This letter is in response to your request for the Virginia Department of Health (VDH) to examine potential public health implications of modeled air pollutants emissions from the proposed compressor station in Buckingham County. Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), VDH evaluated the data set provided on February 26, 2019 by the Virginia Department of Environmental Quality (DEQ). VDH concludes that the modeled air concentrations of pollutants are not a health hazard, because the exposure concentrations are below their respective comparison value. VDH recommends that if the compressor station is constructed, air monitoring pollutant concentrations should be evaluated for public health implications.

BACKGROUND

The Buckingham Compressor Station proposed location is on the north side of Route 56, 5.1 miles northwest of the intersection of Route 60 and Route 56, at 5297 S. James River Highway, Wingina (Buckingham County), Virginia. The facility is a natural gas pipeline compressor station. It is classified as a minor source of air pollution. The station is one of three proposed for the Atlantic Coast Pipeline. Compressor stations are needed to maintain pressure and allow the natural gas to travel over 600 miles from West Virginia to North Carolina. The Buckingham Compressor Station is the only compressor station for the Atlantic Coast Pipeline that will be located in Virginia.

Demographics and land use

The land around the site is forested, with rolling terrain. There are no hospitals, fire stations, nursing homes, police stations, Superfund sites, or industrial complexes within a mile of the proposed compressor station location. Within 0.5 mile of the site there are 15 housing units with a total population of 26 individuals according to 2010 statistics provided by ATSDR (see

Attachment). The population in the area is predominantly white and black (10 individuals each). Potential sensitive populations include four adults over 65 years of age and two children under the age of seven. There are also five women between the ages of 15 to 44.

A researcher from the Friends of Buckingham community group contacted VDH with concerns about environmental justice and provided population demographics from a door to door community population assessment of households within a two-mile radius of the site, which included 100 households (see Attachment). Of the total households identified, 77 responded to the survey, reporting demographic information for 200 people. This includes 50 adults over the age of 65 and 28 children under the age of seven. The researcher's study avers that the population surrounding the proposed compressor station location meets all the criteria of environmental justice vulnerability. Data from the report is included in the Attachment. The researcher also ascertained medical conditions from 35 of the 67 households who were available to complete the entire questionnaire. Reported health conditions include autoimmune conditions (asthma, allergies, multiple sclerosis, lupus), respiratory conditions (COPD, asthma, chronic bronchitis and pneumonia, congestive heart failure), circulatory conditions (heart disease and heart conditions, stroke), diabetes, arthritis, bipolar disorder, cancers (brain and breast), epilepsy, kidney conditions, migraines, light sensitivity, noise sensitivity, and skin disease.[1]

Projected pollutant concentrations

DEQ's permit programs require permit review, including control technology requirements and air quality analysis, if the emissions of a pollutant is over the respective exemption threshold delineated in the regulation.[2] For the Buckingham Compressor Station, the pollutants subject to permitting, and therefore the requirement for an air quality analysis, are NO_2, CO, PM-10, PM-2.5, formaldehyde, and n-hexane (hereafter referred to as hexane) (see Table 1). Pollutants examined by DEQ that were below the threshold are in the Attachment.

DEQ performed an in-depth air quality analysis using dispersion modeling to determine the impact of the emissions from the compressor station. In the modeled impact, DEQ included local sources of air emissions as well as the compressor station. DEQ also reviewed the State monitoring network and selected monitored concentrations with higher nearby populations and higher nearby emissions. This monitored concentration is added to the modeled impact (see Table 1).

The air quality analysis consists of determining the worst-case operating scenario for each pollutant. For this project, equipment emissions are based, in part, on the ambient air temperature. In DEQ's review, the emissions calculations assume operation at 0°F for every hour of the year. This approach determines the maximum amount of emissions allowed during any point in the year. The modeling analysis utilized local meteorological and topographical information. The air quality modeling analysis conforms to *40 CFR Part 51, Appendix W—Guideline on Air Quality Models* and was performed in accordance with approved modeling methodologies.[3] The air quality model used for the analyses was AERMOD (Version 16216r). AERMOD is the preferred EPA-

[1] Lakshmi Fjord, Ph.D. Personal communication July 3, 2019
[2] Patrick Corbett. Personal communication February 1, 2019
[3] https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance Last accessed August 2019.

approved regulatory model for near-field applications (estimates of air concentrations within 50 kilometers of the emission location).

Additional operation considerations

There are several operational considerations warranting mention when reviewing the information. The maximum hourly formaldehyde concentration is driven largely by emissions from an emergency power generator. This unit will be operated for maintenance and readiness testing and when the facility loses power. In general, maintenance and readiness testing is approximately one to two hours per week. Operation during losses of power are not predictable in short-term duration; however, annual operation of the emergency generator for any reason will be less than 500 hours per year. This is the level of operation considered in the annual impact of formaldehyde. Hexane emissions are also intermittent. The highest exposures could happen up to 800 hours per year; however, they are expected to occur less frequently in most years. Hexane emissions are not expected during normal operation but intermittently when the compressor is shut down or started up and during pigging, a process that ensures the pipe is unobstructed.

Modeled concentrations for five nearest homes

VDH was provided modeling concentrations for five separate locations near the future site. These five locations represent the nearest houses to the facility in each direction approximately 800 to 1500 feet from the compressor station. Table 1 contains the pollutant, *maximum* modeled concentration of all five locations, and averaging period.

Table 1. Projected concentration of pollutants subject to permitting

Pollutant	Averaging Period	Highest Modeled Concentration ($\mu g/m^3$)	Highest Total Concentration with Background ($\mu g/m^3$)	Comparison Value ($\mu g/m^3$)	Comparison Value Type
NO_2	1-hour	8.05	83.25	188	NAAQS
NO_2	Annual	0.63	17.55	100	NAAQS
CO	1-hour	120.58	1494.58	40,000	NAAQS
CO	8-hour	18.67	1278.17	10,000	NAAQS
PM-10	24-hour	1.97	28.97	150	NAAQS
PM-2.5	24-hour	1.06	16.06	35	NAAQS
PM-2.5	Annual	0.19	7.39	12	NAAQS
Formaldehyde	1-hour	10.85	10.85	49	Acute EMEG
Formaldehyde	Annual	0.02242	0.02242	0.077	CREG
Hexane	1-hour (Pigging - Receiving)	521.63	521.63	180,000	PEL

Pollutant	Averaging Period	Highest Modeled Concentration (µg/m^3)	Highest Total Concentration with Background (µg/m^3)	Comparison Value (µg/m^3)	Comparison Value Type
Hexane	1-hour (Pigging - Launching)	422.11	422.11	180,000	PEL
Hexane	1-hour (Normal Operations)	3.71	3.71	700	RfC
Hexane	1-hour (Startup Purge)	228.12	228.12	180,000	PEL
Hexane	1-hour (Shutdown Vent)	737.16	737.16	180,000	PEL

NAAQS: National Ambient Air Quality Standard. EMEG: Environmental Media Evaluation Guide. CREG: Cancer Risk Evaluation Guide. PEL: Permissible Exposure Limit (10 hour time-weighted average). RfC: Reference Concentration

DISCUSSION

Exposure pathway evaluation

Chemicals present in the environment above their respective health comparison values can only impact health when an individual is exposed. VDH determines if an exposure to environmental contamination occurred in the past, is occurring, or might occur in the future by identifying if a completed exposure pathways exists. A complete exposure pathway consists of five elements:

Element 1: A source of contamination
Element 2: An environmental medium that can transport the contaminant
Element 3: A location where people might come into contact with the contaminated medium
Element 4: The route by which people physically contact the environmental contaminant
Element 5: Population that may or have come in contact with the contaminants

If all five elements are present then the exposure pathway is considered *complete.* In a *potential* exposure pathway one or more elements are not present, but information is insufficient to exclude the element. In an *eliminated* exposure pathway one or more of the elements is absent. A complete exposure pathway will exist should the compressor station be built (see Table 2).

Table 2. Site specific exposure pathway elements

Pathway Name	Exposure Pathway Elements					Time Frame
	Source (Element 1)	**Environmental Transport Medium** (Element 2)	**Exposure Point** (Element 3)	**Exposure Route** (Element 4)	**Exposed Population** (Element 5)	
Ambient Air	Buckingham Compressor Station	Air	Ambient Air	Inhalation	Community	Future

Contaminant Evaluation

VDH determines if a potential health risk exists by comparing environmental sampling results to ATSDR's environmental comparison values (CVs). CVs represent concentrations of a substance (e.g., in water, soil, and air) to which humans may be exposed via a particular exposure route during a specified period of time without experiencing adverse health effects. Although concentrations at or below the relevant CV may reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a CV would be expected to produce adverse health effects. If ATSDR does not have a CV for a substance, then other federal or state guidelines can be used.

National ambient air quality standards (NAAQS)

The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. Primary standards, used here, provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly.

Environmental media evaluation guides (EMEGs)

EMEGs are estimated contaminant concentrations that are not expected to result in adverse non-carcinogenic health effects based on ATSDR evaluation. They are based on conservative assumptions about exposure, such as intake rate, exposure frequency and duration, and body weight. ATSDR has developed EMEGs that apply to acute (14 days or less), intermediate (15–364 days) and chronic (365 days or more) exposures. Since formaldehyde is only expected to be emitted sporadically, the acute EMEG was selected.[4]

Cancer risk evaluation guides (CREGs)

CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million persons exposed during their lifetime. ATSDR's CREGs are calculated from EPA's cancer slope factors for oral exposures or unit risk values for inhalation

[4] https://www.epa.gov/criteria-air-pollutants/naaqs-table Last accessed August 2019.

exposures. These values are based on EPA evaluations and assumptions about cancer risks at low levels of exposure.

Permissible exposure limit (PEL)

The Occupational Safety and Health Administration sets Permissible Exposure Limits to control a worker's exposure to a chemical during a work day. These limits are calculated to protect workers over an 8-hour work shift during a 40-hour work week and set a time-weighted average concentration that may not be exceeded.

Using permissible exposure limit for hexane

CVs used for this letter are developed to protect the general population and sensitive individuals including children and the elderly. PELs are developed to protect the adult worker population. The hexane modeled concentrations are more than a 100-fold below the PEL. Further evaluation of hexane will not be considered at this time because PELs are developed using safety factors and the modeled concentrations are well below the PEL.

Public health implications

When people are exposed to chemicals, the exposure does not always result in adverse health effects. The type and severity of health effects that may occur in an individual from contact with contaminants depend on the toxicological properties of the contaminants, how much of the contaminant to which the individual is exposed, how often, and how long the individual is exposed. Once exposure occurs, characteristics such as age, sex, nutritional status, genetics, life style, and health status of the exposed individual influence how the individual absorbs, distributes, metabolizes, and excretes the contaminant. These factors and characteristics influence whether exposure to a contaminant could or would result in adverse health effects.[5]

Because all of the concentrations modeled fall below their applicable health based CV, additional public health risk assessment is not warranted.

Approach to using air modeling

This analysis is based on dispersion modeling data provided by DEQ that was developed during the permitting process. While DEQ has stated the modeling outputs are conservative and will not result in higher actual air concentrations than represented in the results, VDH prefers the use of actual monitored data when performing a health consultation. VDH and DEQ will revisit this health consultation should actual monitored data become available in the area.

[5] ATSDR 2005. Public Health Assessment Guidance Manual (Update). Agency for Toxic Substances and Disease Registry. 2005

CONCLUSION

The modeled air concentrations of pollutants are not a health hazard, because the exposure concentrations are below their respective comparison value.

RECOMMENDATION

VDH recommends that if the compressor station is constructed, air monitoring pollutant concentrations should be evaluated for public health implications

If you have any questions about this report or additional information to review please contact me by phone at (804) 864-8127 or by email at dwight.flammia@vdh.virginia.gov.

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ATTACHMENTS

Buckingham Compressor Station

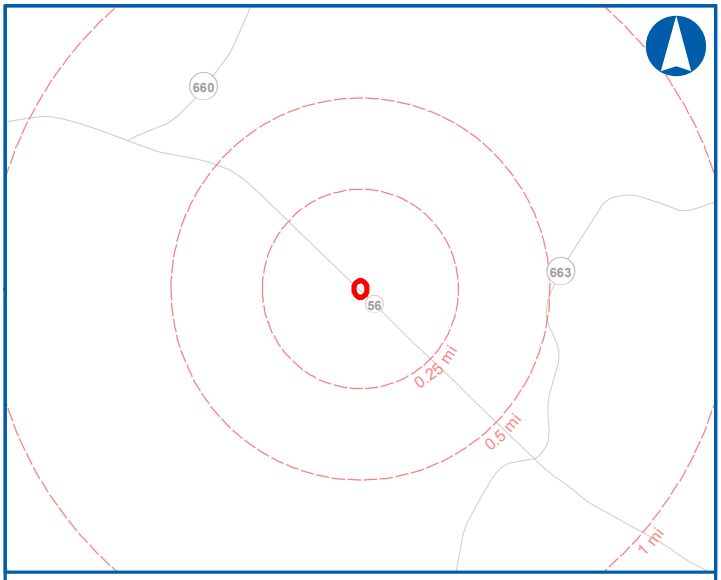
Buckingham, Buckingham County, VA

GENERAL SITE PROFILE

EPA FACILITY ID VASAIDS5440

INTRODUCTORY MAP SERIES

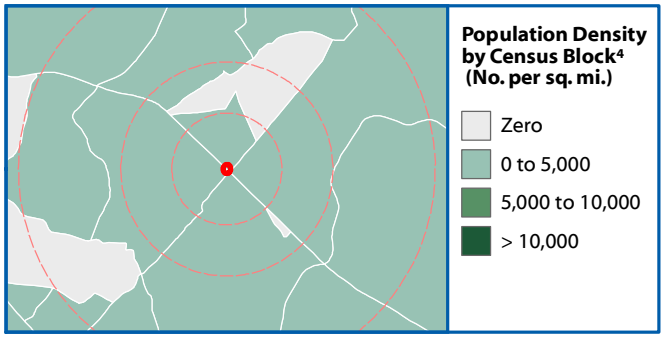
Site Vicinity Map



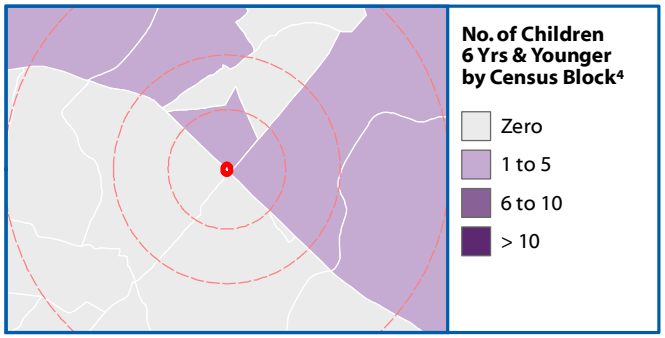
Site of Interest[1]
Site of Interest Buffers[2]
Park[3]
Industrial[3]
Airport[3]
Military Base[3]

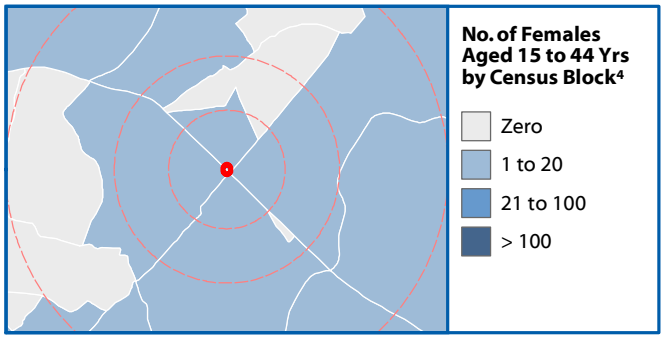
The **General Site Profile Map** depicts the hazardous waste site of interest, along with any airport, industrial, military, or park land uses. It also provides community demographic and housing statistics.

General Population Density



Sensitive Populations





Demographic Statistics[4,5]

Within 0.5 Miles buffer of site boundary

Measure	2000	2010	Change
Total Population	29	26	-10%
White Alone	11	10	-9%
Black Alone	18	10	-44%
Am. Indian & Alaska Native Alone	0	1	N/A
Asian Alone	0	0	+0%
Native Hawaiian & Other Pacific Islander Alone	0	0	+0%
Some Other Race Alone	0	2	N/A
Two or More Races	1	2	+100%
Hispanic or Latino[6]	0	2	N/A
Children Aged 6 and Younger	1	2	+100%
Adults Aged 65 and Older	3	4	+33%
Females Aged 15 to 44	7	5	-28%
Housing Units	14	15	+7%
Housing Units Pre 1950	10	4	-60%

Data Sources: [1]ATSDR GRASP Hazardous Waste Site Boundary Database. [2]ATSDR GRASP. [3]TomTom International BV (2012). [4]US Census 2010. **Notes:** [5]Calculated using area-proportion spatial analysis method. [6]Individuals identifying origin as Hispanic or Latino may be of any race.
Projection: Projection used for all map panels is NAD 1983 StatePlane Virginia South FIPS 4502 Feet.

PRJ 05440 JXA0 2/12/19

GRASP

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences

ATSDR

FINAL - FOR PUBLIC RELEASE

Union Hill Household Study (01-02-2019)
Lakshmi Fjord, Ph.D.

100 households were identified by US postal service markers in the ¼-mile to 2-mile radius of Union Hill, Buckingham, Virginia -- site chosen for Atlantic Coast Pipeline Virginia compressor station. ACP used Buckingham County's 2010 average person per square mile census data - 29.6 people - as the site population.

Our study teams reached **77 households of 100** households for a 77% response rate.

Weekday residents of 77 households: **200**
Weekend, bi-monthly, and annual family reunion numbers add hundreds more frequent visitors.

Of the 67 households for which we have a full set of data, **42 or 62.6% are known descendants** of formerly enslaved people at nearby plantations.

8 households report unmarked slave and freedmen graves on their property or nearby.

Race by self-identification: Taken together **minorities make up 83.5%** of residents:

	African American	Native American and African American	White	Native American and White	Native American	Hispanic	Asian
Count	124	27	33	9	3	3	1
%	62	13.5	16.5	4.5	1.5	1.5	.5

Weekday residents' ages: 32% are Children; 25% Elderly. Both age ranges mask actual ages that are disproportionately the very young and very old (age range used to protect confidentiality):

Age Range	0-6	7-18	18-21	22-40	41-65	65+	Unknown	Total
Count	28	36	5	36	43	50	2	200
%	14	18	2.5	18	21.5	25	1	100

Health Data: For the 67 households where we were able to have extensive questionnaire time, **35 responded with pre-existing medical diagnoses** or **59.32% of reached households**.

Highest levels of existing diagnosed health conditions are for autoimmune conditions (asthma, allergies, multiple sclerosis, lupus) and lung/respiratory conditions (COPD, asthma, chronic bronchitis & pneumonia, congestive heart failure), circulatory conditions (heart disease and heart conditions, stroke) and diabetes -- all known to be caused by environmental toxins and exacerbated by them. Other conditions include arthritis, bipolar disorder, cancers (brain and breast cancer), epilepsy, kidney condition. migraines, light sensitivity, noise sensitivity, and skin disease.

Chemicals exempt from air analysis and their estimated emissions

Pollutant	CAS No.	Exemption Rate		Facility Emissions	
		Hourly (lb/hr)	Annual (tons/yr)	Hourly (lb/hr)	Annual (tons/yr)
1,3-Butadiene	106990	1.452	3.19	0.001	4.79E-04
2,2,4-Trimethylpentane	540841	22.8	50.75	0.001	2.52E-05
Acetaldehyde	75070	8.91	26.1	0.102	0.045
Acrolein	107028	0.02277	0.03335	0.016	0.007
Benzene	71432	2.112	4.64	0.032	0.013
Ethylbenzene	100414	17.919	62.93	0.083	0.036
Naphthalene	91203	2.607	7.54	0.003	0.001
Polycyclic aromatic hydrocarbons	—	2.607	7.54	0.006	0.002
Propylene Oxide	75569	3.168	6.96	0.074	0.032
Toluene	108883	18.645	54.665	0.332	0.145
Xylenes	1330207	21.483	62.93	0.164	0.071

CAS: chemical abstract number. lb/hr: pounds per hour. yr: year.